WHAT IS CLAIMED IS:

1. A lithographic projection apparatus comprising:

a radiation system configured to provide a beam of radiation;

a support structure to support a patterning device configured to pattern the beam of radiation according to a desired pattern;

a substrate holder to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

an interferometric measuring system configured to measure displacement of a target object, said target object being a displaceable component of said apparatus;

a second harmonic interferometer configured to measure atmospheric conditions along an optical path; and

a control system responsive to said second harmonic interferometer and configured to apply corrections to measurements of said interferometric measuring system;

wherein said control system is configured to remove from measurements of said second harmonic interferometer any dependence on the length of said optical path before said measurements are used to apply corrections to measurements of said interferometric measuring system.

2. The apparatus according to Claim 1 wherein said control system corrects measurements of said interferometric measuring system using the formula:

$$L = \lambda_r N_r - K(\lambda_u N_u - P^* \lambda_r N_r)$$

where

$$P^* = \alpha_u - \alpha_g$$

$\lambda_{rv} = (1 + \alpha_r)\lambda_r$ represents a vacuum wavelength of the measurement beams of said interferometric measuring system,

$K = \alpha_r / (\alpha_u - \alpha_g)$,

λ_u represents a short vacuum wavelength of the second harmonic interferometer,

N_u represents a fringe count of the second harmonic interferometer, and

$\alpha_r, \alpha_g, \alpha_u$ represents the refractivities of air at the wavelength of measurement beams and the long and short wavelengths of the second harmonic interferometer, respectively.

3. The apparatus according to Claim 1, wherein said control system is adapted to divide said measurements of said second harmonic interferometer by an amount representing said length of said optical path.

4. The apparatus according to Claim 1, wherein said target object comprises said substrate holder.

5. A lithographic projection apparatus comprising:

a radiation system configured to provide a beam of radiation;

a support structure to support a patterning device configured to pattern the beam of radiation according to a desired pattern;

a substrate holder to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

an interferometric measuring system configured to measure displacement of a target object, said target object being a displaceable component of said apparatus;

a second harmonic interferometer configured to measure atmospheric conditions along an optical path;

a control system responsive to said second harmonic interferometer configured to apply corrections to measurements of said interferometric measuring system;

wherein measurement beams of said interferometric measuring system and said second harmonic interferometer are directed against and reflected by a same mirror on said target object; and

wherein said mirror on said target object is provided with a protective

coating having a nominal thickness such that the sensitivity of measurements of said second harmonic interferometer to variations in the thickness of said coating is minimized.

6. The apparatus according to Claim 5, wherein said nominal thickness T meets one of the following criteria:

$T = (50 \pm 10)\ nm + (p \times \lambda_u / n_{coating})$,

$T = (110 \pm 10)\ nm + (p \times \lambda_u / n_{coating})$, or

$T = (170 \pm 20)\ nm + (p \times \lambda_u / n_{coating})$

where p is a non-negative integer, λ_u is the short vacuum wavelength of the second harmonic interferometer and $n_{coating}$ is the refractive index of the coating at λ_u.

7. The apparatus according to Claim 5, wherein said coating is formed of SiO_2.

8. The apparatus according to Claim 5, wherein said target object comprises said substrate holder.

9. A lithographic projection apparatus comprising:

a radiation system configured to provide a beam of radiation;

a support structure to support a patterning device configured to pattern the beam of radiation according to a desired pattern;

a substrate holder to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

an interferometric measuring system configured to measure displacement of a target object, said target object being a displaceable component of said apparatus;

a second harmonic interferometer configured to measure atmospheric conditions along an optical path;

a control system responsive to said second harmonic interferometer and configured to apply corrections to measurements of said interferometric measuring system;

wherein said second harmonic interferometer comprises:

a first Brewster prism to receive the beams of said second harmonic interferometer;

a first detector to receive radiation reflected by said first Brewster prism;

a quarter-wave plate configured to introduce a 90° phase shift between two beams transmitted by said first Brewster prism;

a second Brewster prism to receive beams that have traversed said quarter-wave plate;

a second detector to receive beams reflected by said second Brewster prism; and

a third detector to receive beams transmitted by said second Brewster prism.

10. The apparatus according to Claim 9, wherein said target object comprises said substrate holder.

11. The apparatus according to Claim 9, wherein said first Brewster prism for receiving the beams of said second harmonic interferometer has a principal plane at ±45° to the polarizations thereto.

12. The apparatus according to Claim 12, wherein said beams reflected by said first Brewster prism and reflected and transmitted by said second Brewster prism are conducted to the respective ones of said first, second, and third detectors by optical fibers.

13. The apparatus according to Claim 13 wherein said second harmonic interferometer further comprises a half-wave plate to rotate the planes of polarization of two cross-polarized beams that have traversed said optical path and located before the first Brewster prism.

14. A lithographic projection apparatus comprising:

a radiation system configured to provide a beam of radiation;

a support structure to support a patterning device configured to pattern the beam of radiation according to a desired pattern;

a substrate holder to hold a substrate;

a projection system to hold the patterned beam onto a target portion of the substrate;

an interferometric measuring system employing an interferometric measuring beam to measure displacement of a target object, said target object being a displaceable component of said apparatus;

a second harmonic interferometer employing second harmonic interferometer measuring beams to measure atmospheric conditions along an optical path;

a control system responsive to said second harmonic interferometer and configured to apply corrections to measurements of said interferometric measuring system; and

a beam combiner for spatially combining said interferometric measuring beam and said second harmonic interferometer measuring beams;

wherein said beam combiner comprises:

a dichroic mirror configured to transmit said interferometric measuring beam and reflecting said second harmonic interferometer measuring beams and oriented at 45° to said interferometric measuring beam; and

a wave plate to ensure that the polarization of the beams reflected and transmitted by the dichroic mirror are purely S or P polarized.

15. The apparatus according to Claim 14, wherein said target object comprises said substrate holder.

16. The apparatus according to Claim 14, wherein said wave plate is a half-wave plate to the long wavelength one of said second harmonic interferometer beams and a quarter wave plate to the short wavelength one of said second harmonic interferometer beams and said interferometric measuring beam, said wave plate being positioned between said dichroic mirror and said target object.

17. The apparatus according to Claim 16, wherein said beam combiner further comprises a quarter wave plate to change the polarization of the beam going from said

interferometric displacement measuring system towards said target object from circular to linear and for changing the polarization of the returning beam from linear to circular.

18. A lithographic projection apparatus comprising:

a radiation system configured to provide a beam of radiation;

a support structure to support a patterning device configured to pattern the beam of radiation according to a desired pattern;

a substrate holder to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

an interferometric measuring system using an interferometric measuring beam to measure displacement of a target object, said target object being a displaceable component of said apparatus ;

a second harmonic interferometer using second harmonic interferometer to measure beams for measuring atmospheric conditions along an optical path;

a control system responsive to said second harmonic interferometer configured to apply corrections to measurements of said interferometric measuring system; and

a beam combiner to spatially combine said interferometric measuring beam and said second harmonic interferometer measuring beams;

wherein said beam combiner comprises:

a dichroic mirror for transmitting said interferometric measuring beam and reflecting said second harmonic interferometer measuring beams; and

first and second wave plates respectively located between the interferometric measuring and said dichroic mirror and between said second harmonic interferometer and said dichroic mirror for correcting the polarization of the beams reflected and transmitted by the dichroic mirror.

19. The lithographic projection apparatus according to Claim 18, wherein said dichroic mirror is arranged for transmitting said interferometric measuring beam and reflecting said second harmonic interferometer measuring beams and oriented at 45° to said

interferometric measuring beam.

20. A device manufacturing method, comprising:

providing a substrate that is at least partially covered by a layer of radiation-sensitive material;

projecting a patterned beam of radiation onto a target portion of the layer of radiation-sensitive material;

measuring displacement of a target object using an interferometric displacement measuring system;

measuring atmospheric conditions along an optical path; and

correcting measurements of said interferometric displacement measuring system responsive to measurements of said atmospheric conditions; and

removing from said measurements of atmospheric conditions any dependence on the length of said optical path before correcting measurements of said interferometric displacement measuring system.